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"DIVERSITY STUDIES IN BIRD'S EYE CHILLI (*CAPSICUM FRUTESCENS* L.) ACCESSIONS"

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ABSTRACT

A study on genetic diversity was conducted with 36 bird's eye chilli (Capsicum frutescens L.) accessions through Mohalanobis D^2 and principal component analysis for twenty seven quantitative characters viz., plant height, number of primary branches per plant, days to first flowering, days to 50% flowering, days taken for flowering to fruit set, days taken for physiological maturity, number of fruits per plant from five pickings, fruit length, fruit width, fruit yield per plant, fresh and dry weight of 100 fruits, number of seeds per fruit, 1000 seed weight, weight of seeds per fruit, fruit to seed ratio, yield quintal per hectare, pedicel length, vitamin-C, capsaicin, oleoresin and capsanthin contents were taken into consideration. Cluster analysis was used for grouping of 36 accessions and the accessions were fallen into six clusters. Cluster VI had maximum (14) and cluster III had the minimum number (1) of accessions. The highest inter-cluster distance was observed between cluster II and IV and the least between cluster II and III. The character dry weight of 100 fruits contributed maximum to the genetic diversity. It is desirable to select accessions from the clusters having high inter cluster distance for the future breeding program.

KEYWORDS: Capsicum Frutescens, Bird's Eye chilli & Diversity

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Original Article

INTRODUCTION

Capsicum frutescens L. is one among the five cultivated species of the genus and is closely related to *C. chinense* Jacq. Numerous local land races of *C. frutescens* are cultivated in tropical and subtropical regions of the world (Heiser and Smith, 1953). Bird's eye chilli is called by many other synonyms like African pepper, chilli pepper, goat's pod, Mexican chilli, red pepper, Tabasco pepper, Zanibar pepper and Cayenne pepper whose small, very pungent fruits separate easily from calyx. The name bird's eye chilli because, birds love to pick the ripe chilli. The plant originated in South America and introduced to India towards 16th century. It is a wild form of chilli and often used to denote any small sized, pointed chilli of high pungency. Bird's eye chilli has been grown as a neglected crop in very few pockets of the world and in India. In India all kinds of bird's eye chillies are found scattered all over the north-eastern region from Sikkim to Arunachal to Assam to Myanmar (Baruah and Barua, 2004). In India it is grown as a homestead crop and consumed widely across malnad regions of South Karnataka, Kerala, Tamil Nadu and in north-east India, particularly in the states of Mizoram and Manipur. The north-eastern hill (NEH) region, being one of the hot-spots of biodiversity in the Indian gene centre, is also known for its richness in ethnic diversity and traditional culture (Dutta *et al.,* 2015). Among the north-eastern states of India, Mizoram is known for the presence of incredible diversity of bird's eye chilli, with respect to fruit shape, size,

color, pungency, plant type, physiological characteristics, reactions to diseases and pests, adaptability and distribution (Ozgur *et al.,* 2011). Huge diversity of the crop with respect to these characters is found in these areas and holds a huge scope and potential in these areas (Dutta *et al.*, 2015).

Capsaicin (8-Methyl-N-vanillyl-trans-6-nonenamide) and di-hydro capsaicin (DHC) are major contributors to pungency and forms about one-third (69%) of the total capsaicin. The capsaicin content ranges from 0.26 to 1.21% w/w or 1,00,000-1,50,000 scoville heat units (SHU) (Bosland, 1993). Most bird's eye chillies are processed to extract the oleoresin for sale to the food and pharmaceutical industries due to its high pungency, color and medicinal properties. In medicine, the bird's eye chili was traditionally used to ease arthritis and rheumatism and also as a cure for dyspepsia, flatulence and toothache (Chatterjee *et al.*, 2012).

Assessment of different desirable traits spread over diverse genotypes is important to rapid advance in yield improvement of any crop (Gaur *et al.,* 1978). Moreover, evaluation of genetic diversity is important to know the source of genes for a particular trait within the available germplasm (Tomooka, 1991). Genetic divergence is a basic requirement for effective selection within the existing population or population arising out of hybridization. More diverse the parents within a reasonable range, better are the chances of improving economic characters under consideration in the offspring. Mohalanobis's D^2 statistic of multivariate analysis is recognized as a powerful tool in quantifying the degree of genetic divergence among the populations. Therefore, the present study was undertaken to assess the genetic diversity in 36 accessions of bird's eye chilli and to identify suitable donors for a successful breeding program in this crop.

MATERIAL AND METHODS

A field experiment was conducted at college of Horticulture, Mudigere, during the period from August 2015 to March 2016. The experiment was designed to study the diversity in bird's eye chilli (*Capsicum frutescens* L.). The experiment was laid out in Randomised Complete Block Design (RCBD) with two replications. The experiment consisted of thirty six accessions collected from different locations. The seeds were sown in protrays with suitable potting mixtures and 45 days old seedlings were transplanted to a main field at a spacing of 1m x 1m. FYM and fertilizers were applied as per the recommendations. The recommended cultural practices were followed for raising good crop. Observations were taken on five randomly selected plants, multivariate analysis Mahalonobis (1936) was carried out, grouping of accessions was done, by using Tocher's method as given by Rao (1952).

RESULT AND DISCUSSIONS

Based on the relative magnitude of D^2 estimates, 36 accessions were grouped into six clusters (Table 1 & figure.1). Cluster VI contained the highest number of accessions (14), followed by cluster II constituted by seven accessions. Cluster I and IV with five accessions each, cluster V with four accessions and cluster III was composed of single accession Acc.14 indicated that this accession is totally different from other accessions used in this study. The pattern of clustering revealed that prevalence of certain extent of diversity in the materials maintained. Warade *et al.* (1997) also noticed maximum diversity in the accession studied.

Intra (bold) and inter cluster distances shown in Table 2. The inter-cluster distance was maximum between clusters II and IV (40317920.00) indicating wide genetic diversity between these two clusters. Genotypes from these two clusters if involve in hybridization may occur a wide spectrum of segregating population as genetic diversity is very distinct among the groups. The selection of diverge genotype from cluster would produce a broad spectrum of variability

for morphological and quality traits studied which may enable further selection and improvement (Hasan *et al.,* 2014). The minimum inter-cluster distance was observed between cluster II and cluster III (119665.00) indicated close relationship among the accessions included. Intra cluster distances were observed in cluster I, II, IV, V and cluster VI whereas, remaining cluster comprised of only one constituent accession (III). The intra cluster distance was highest in cluster I (2286054.00), followed by cluster V (2051044.00) and least in cluster II (1013005.00).

Cluster mean value of 27 different characters shown in Table 3. Difference in cluster means existed for almost all the characters studied. Highest mean value for plant height (cm), number of primary branches per plant, plant spread (cm^2), number of fruits per plant from five pickings, fruit length (cm), fruit width (cm), yield per plant (g), fresh and dry weight of 100 fruits (g), number of seeds per fruit, weight of seeds per fruit (mg), pedicel length (cm), yeld (q/ha), capsaicin content (%) and capsanthin content (color units) was observed in cluster IV that means the accessions fallen in cluster IV having the genetic potentiality to contribute better for yield maximization of chilli accessions. Cluster II had the accessions that showed least mean value for almost all the characters studied indicating selection of accessions from these cluster for future breeding programme have no positive impact. This result is in confirmation with results of Varalakshmi and Haribabu (1991) in chilli (*Capsicum annuum* L.).

Relative contribution towards divergence presented in Table 4. Dry weight of 100 fruits contributed maximum (36.67%) to the genetic diversity among the characters, followed by weight of seeds per fruit (14.13%), oleoresin content (8.03%), yield (6.98%) and vitamin-C content (7.62%). However, there was no substantial contribution from pedicel length (4.78%), number of fruits per plant from 3^{rd} picking (4.60%), capsaicin content (4.60%), capsanthin content (3.65%), test weight (2.96%), number of seeds per fruit (1.43%), days taken for physiological maturity (1.27%), number of fruits per plant from fifth picking (1.27%), fruit to seed ratio (0.95%), number of fruits per plant from first picking (0.79%), fruit width (0.63%), days taken for fifty per cent flowering (0.48%), days taken for flowering to fruit set (0.48%), days to first flowering (0.32%), plant spread (0.16%), number of fruits per plant from 2^{nd} picking (0.16%) and fruit yield per plant (0.16%). There was no contribution for genetic divergence from plant height, number of primary branches per plant at harvest, number of fruits per plant from 4^{th} picking and fruit length. Present findings are accordance with the findings of Begum (2002) and Prabhudeva (2003).

Maximum inter cluster distance was observed between cluster II and IV (40317920.00) indicating that Acc. 2, Acc.4, Acc.10, Acc.13, Acc.18, Acc.24, Acc.25, Acc.20, Acc. 23, Acc. 27, Acc.34 and Acc.35 are highly divergent. These two clusters revealed substantial difference in the means for important yield contributing traits like 100 dry fruit weight and number of seeds per fruit suggesting that the accesions belonging to these clusters form ideal parts for initiating hybridization in future breeding programme. Cluster IV recorded highest dry weight of 100 fruits because it recorded higher values for all the fruit related traits as well as yield related traits. Whereas the least value of these traits was recorded by cluster II forming least performing group for fruit and yield related traits. Grouping of six clusters indicated that no firm conclusion regarding relation between genetic divergence and geographical distance in chilli in general and more particularly in the population under study can be made. Consequently, it is suggested that choosing parents for hybridization or for crop improvement programmes need not necessarily based on geographical distance. This is in confirmation with results of Varalakshmi and Haribabu (1991); Singh and Singh (1976) in chilli.

CONCLUSIONS

D^2 cluster analysis revealed wide genetic distance (inter cluster) between the accessions of cluster II (Acc.2,

Acc.4, Acc.10, Acc.13, Acc.18, Acc.24 and Acc.25) and IV (Acc.20, Acc.23, Acc.27, Acc.34 and Acc.35) and the crossing between accessions of these two clusters can be exploited for the development of heterotic hybrids in future breeding programmes. The clusters I, III and IV were found superior for one or more characters. Therefore, a multiple crossing programme can be proposed involving accessions from these clusters for the development of superior segregants in advanced generations with high yield potential combined with better quality in bird's eye chilli.

Table 1: Classification of Bird's Eye Chilli Accessions into Clusters Based on D^2 Value

Clusters	Number of Accessions	Accessions included in the cluster
I	5	Acc. 5, Acc. 6, Acc. 7, Acc. 9, Acc. 17
II	7	Acc. 2, Acc.4, Acc.10, Acc. 13, Acc. 18, Acc. 24, Acc. 25
III	1	Acc. 14
IV	5	Acc. 20, Acc. 23, Acc. 27, Acc.34, Acc. 35
V	4	Acc. 22, Acc. 26, Acc. 28, Acc. 29
VI	14	Acc. 1, Acc. 3, Acc. 8, Acc. 11, Acc. 12, Acc. 15, Acc. 19, Acc. 16, Acc. 21, Acc. 30 Acc. 31, Acc. 32, Acc.33, Acc. 32, Acc. 36

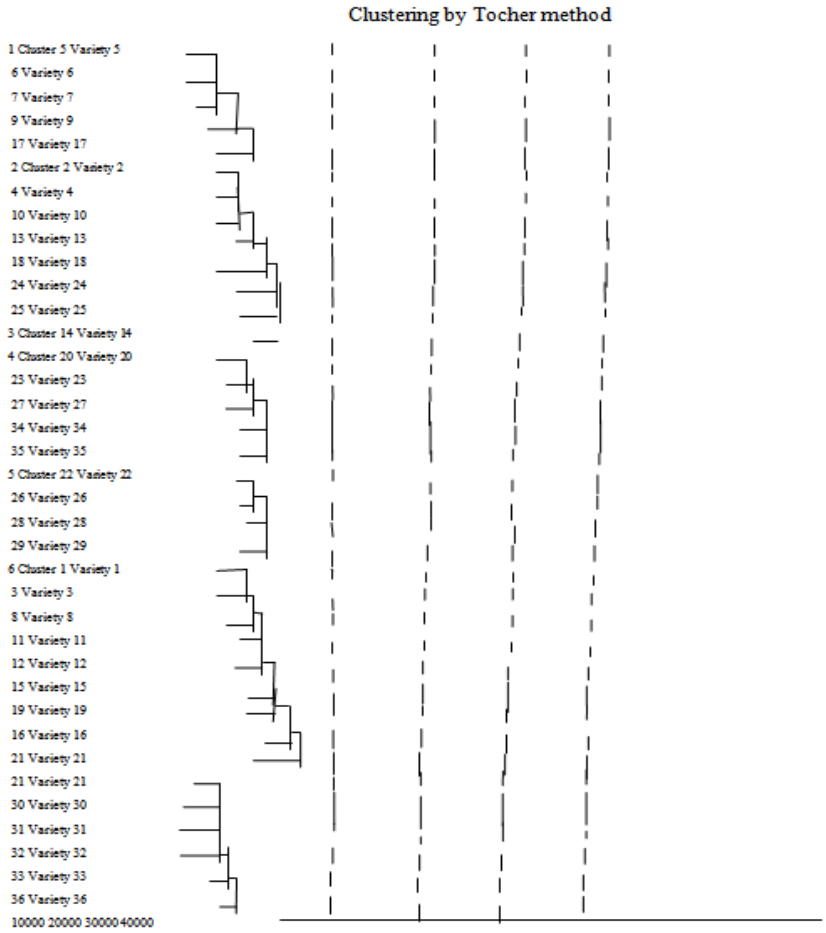

Figure 1: Grouping of bird's Eye Chilli Accessions Based on Tocher's Value (Dendrogram)

Table 2: Percent Contribution from Different Characters to the Total Divergence in Bird's Eye Chilli Accessions

Characters	Number of Times Ranked First	Contribution to Total Divergence Percent (%)
Plant hight (cm) at 120 DAT	0	0.00
Number of primary branches per plant at harvest	0	0.00
Plant spread (cm^2) at 120 DAT	1	0.16
Days to first flowering	2	0.32
Days to 50 per cent flowering	3	0.48
Days taken for flowering to fruit set	3	0.48
Days taken for physiological maturity	8	1.27
Number of fruits per plant per 1^{st} picking	5	0.79
Number of fruits per plant per 2^{nd} picking	1	0.16
Number of fruits per plant per 3^{rd} picking	29	4.60
Number of fruits per plant per 4^{th} picking	0	0.00
Number of fruits per plant per 5^{th} picking	8	1.27
Fruit length (cm)	0	0.00
Fruit width (cm)	4	0.63
Fruit yield per plant (g)	1	0.16
Fresh weight of 100 fruits (g)	0	0.00
Dry weight of 100 fruits (g)	231	36.67
Number of seeds per fruit	9	1.43
Weight of seeds per fruit (mg)	89	14.43
Fruit to seed ratio	6	0.95
Test weight (g)	18	2.96
Yield (q/ha)	44	6.98
Pedicel length (cm)	30	4.78
Vitamin-C content (mg/100g)	48	7.62
Capsaicin content (%)	29	4.60
Oleoresin content (%)	38	8.03
Capsanthin content (Colour units)	23	3.65

Note: DAT- Days After Transplanting

Table 3: Intra and Inter Cluster D^2 and D Values in Bird's Eye Chilli Accessions

Clusters	I	II	III	IV	V	VI
I	**2286054.00**	3541867.00	3035543.00	24313310.00	4053647.00	12046400.00
II		**1013005.00**	119665.00	40317920.00	4412323.00	21606100.00
III			**0.00**	38144750.00	3181384.00	21001200.00
IV				**1226010.00**	30669070.00	9501286.00
V					**2051044.00**	20890530.00
VI						**1518000.00**

Table 4: The Mean Values of Thirteen Characters for 6 Clusters in Bird's Eye Chilli Accessions

@ *	I	II	III	IV	V	VI
1	73.71	67.97	77.72	89.56	74.35	74.17
2	6.01	5.10	6.50	7.20	5.70	5.80
3	46.20	34.74	43.60	56.61	39.95	48.57
4	62.24	66.73	65.35	55.86	65.75	62.87
5	80.75	85.85	83.73	75.14	82.47	83.05
6	7.35	7.76	7.41	7.19	7.70	7.38
7	149.03	147.83	145.95	134.15	149.75	149.69
8	103.52	50.15	60.85	313.85	61.32	100.25
9	127.11	62.07	74.03	355.95	95.09	183.33
10	229.96	123.15	148.04	713.46	100.15	200.38
11	120.90	44.71	55.87	300.19	185.24	250.51
12	57.29	28.26	31.44	98.79	34.57	182.25
13	1.92	1.67	1.55	2.52	1.82	1.61
14	0.51	0.43	0.43	0.55	0.40	0.42
15	25.70	8.07	16.14	34.74	16.21	15.43
16	42.01	16.83	22.67	62.67	22.97	24.76
17	19.49	13.94	16.76	28.74	12.32	13.40
18	0.08	0.08	0.07	0.14	0.04	0.06
19	6.58	2.79	3.42	6.51	5.65	5.12
20	1.49	1.83	1.88	2.21	2.25	1.57
21	535.46	319.76	598.24	770.99	506.20	589.95
22	5.68	1.48	2.38	14.69	2.68	3.55
23	2.16	2.11	2.01	2.51	1.49	2.04
24	91.84	70.27	132.33	108.19	112.06	55.98
25	0.95	0.80	0.93	0.98	0.85	1.01
26	4.21	2.15	0.94	3.15	10.19	0.65
27	356.80	331.01	392.43	396.26	373.32	358.68

Note: @ Characters * Clusters

1. Plant height (cm) at 120 DAT
2. Number of primary branches at harvest
3. Plant spread (cm^2) at 120 DAT
4. Days to first flowering
5. Days to 50 per cent flowering
6. Days taken for flowering to fruit set
7. Days taken for physiological maturity
8. Number of fruits per plant per 1^{st} picking
9. Number of fruits per plant per ^{2nd} picking
10. Number of fruits per plant per 3^{rd} picking
11. Number of fruits per plant per 4^{th} picking
12. Number of fruits per plant per 5^{th} picking
13. Fruit length (cm)
14. Fruit width (cm)
15. Fruit yield per plant (g)
16. Fresh weight of 100 fruits (g)
17. Dry weight of 100 fruits (g)
18. Number of seeds per fruit
19. Weight of seeds per fruit (mg)
20. Fruit to seed ratio
21. Test weight (g)
22. Pedicel length (cm)
23. Yield (q/ha)
24. Vitamin-C content (mg/100g)
25. Capsaicin content (%)
26. Oleoresin content (%)

27. Capsanthin content (Color units)

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